

Search for Higgs boson pair production in $\tau\tau$ final state

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Searches are performed for non-resonant and resonant di-Higgs boson production in the $\tau\tau$ final state. The data set used corresponds to an integrated luminosity of 139 fb^{-1} of proton–proton collisions at a center-of-mass energy of 13 TeV recorded by the ATLAS detector at the CERN Large Hadron Collider. No excess with respect to background expectations is found and upper limits on the di-Higgs boson production cross sections are set. A 95% confidence level upper limit of 130 fb is set on the $gg \rightarrow \tau\tau$ non-resonant production, where the expected limit is 180 fb. The observed (expected) limit corresponds to 4.1 (5.5) times the cross section predicted by the Standard Model. The observed (expected) limit on the Higgs boson trilinear coupling modifier κ_3 is extracted to be $[-1.5, 6.7]$ ($[-2.4, 7.7]$) at 95% confidence level. The constraints on κ_3 are obtained over an expected background hypothesis excluding $gg \rightarrow \tau\tau$ production. For the resonant production of a new hypothetical scalar particle ϕ ($gg \rightarrow \phi \rightarrow \tau\tau$), limits on the cross section $gg \rightarrow \phi \rightarrow \tau\tau$ are presented for the narrow-width approximation as a function of m_ϕ in the range $251 \text{ GeV} \leq m_\phi \leq 1000 \text{ GeV}$. The observed (expected) limits on the cross section $gg \rightarrow \phi \rightarrow \tau\tau$ range from 610 fb to 47 fb (360–43 fb) over the considered mass range.

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